

THE ACCIDENT INVESTIGATION CENTRAL DIRECTORATE
CIVIL AVIATION AUTHORITY
MINISTRY OF AVIATION

FINAL AIRCRAFT ACCIDENT REPORT

ANTONOV - 12

REGISTRATION ST-SIG

04-100-0
ST-SIG
E.4644

LOCATION 1208010 N
 03008851 E

HABILA AGRICULTURE SCHEME

ON 11/05/2004

AT 13:18 UTC

This report contains facts which have been determined up to the time of issue

Date 23/02 2005

Ref: CAA/7/ACC/ST-SIG/7-04

AIRCRAFT ACCIDENT FINAL REPORT
Accident to AN-12, Reg. ST-SIG on 11/05/04

SYNOPSIS

The Accident Investigation Central Directorate, CAA Sudan was notified about This accident by Elobied ATC on 11/05/04 at 15:00 UTC.

An Investigation Board was formed by the DGCA in accordance with Sudan Air Law comprising :

Engineer : Abdelsamie Adam Ali

Engineer : Motaz Ahmed Shoora

Captain : Sayed Kamal Elsayed

A. Officer: Mohamad Elhassan Taha

Navigator : Aidaros Eltaaib Mustafa

The aircraft AN-12, ST-SIG departed Juba Airport on a flight to Elobied at 11:40 UTC on 11/5/04 with 7 crew members. The estimated time for arrival at Elobied Airport 13:30. At 13:05 ST-SIG requested descend and was cleared for FL 60.

At 13:15 the ATC was repeatedly calling the aircraft but there was no Reply from the aircraft.

On the morning of 12/05/04 Elobied Airport received a message from the Armed Forces informing that the aircraft was found crashed in a forest near a Village called Eltateil at Habilla Agricultural Scheme. The Investigation Board visited the crash site on 12/05/04.

Note

Objective of the investigation is not to apportion blame or liability. The objective of the investigation is the prevention of accidents and incidents. Safety recommendations are addressed to the Regulatory Authorities of the State having responsibility for such matters. It is for those Authorities to decide what action to be taken.

1 - Factual Information

The Antonov 12 A Serial No . 1400101 Registration ST-SIG entered in Sudan Register for Civil Aircraft on 16/07/2003 was owned by Elmagal Aviation Services .

The aircraft serial No. 1400101 was withdrawn from the Civil Aircraft Register of Ukraine on 05/07/2003 and was exported to Kazakhstan according to export Airworthiness Certificate No. BE 0450 dated 05/07/2003 . The former registration was UR - 48975 . The aircraft arrived Khartoum Airport during the period 3-5 July 2003 check No . 10.... was carried out at Sharjah UAE on 18/12/2003 and its flying time till date of accident was about 388:25 hrs . On 06/04/2004 the aircraft carried cargo from Ellobied to Juba and due to some problems within the Crew the aircraft was grounded at Juba till 27/4/2004 the day it arrived Khartoum and stay on ground at Khartoum Airport till 09/05/2004 the day it left to Ellobied.

The Company contracted an Armenian Captain who arrived Khartoum on 05/05/2004 and during a meeting at the Company Office , in the presence of Company Manager the First Officer who was the Operation Manager , Three Iraqis a Navigator , Flight Engineer and a Electrical Engineer , an Armenian Engineer and airframe Technician and another two Sudanese , a Flight Engineer and a Navigator .

The three Iraqis had not got a Sudanese Validation and they were not current on AN-12 for more than 10 years . They carried out competency check on IL 78 simulators and the Sudanese Navigator License was expired some years ago . As came to our Knowledge the Armenian Captain insisted to have a crew of some Armenians he Knew . Somehow he was convinced to fly with the above mentioned crew on 09/05/04 to carry out the designated flights .

The aircraft left Khartoum to Ellobied on 09.05.04 morning with the above - mentioned crew after being refueled with 13500 kgs. of jet A.

On the same day the aircraft carried out two flights to Juba from Ellobied carrying general cargo (Dura Sacks) and after each return flight being refueled with 2552 I.G (9018 kgs) at Ellobied .

On the 10/05/2004 two flights to Juba were being executed and same quantity of fuel was picked up .

On the 11/05/2004 the aircraft made its first flight to Juba at 02:45 UTC and arrived back Ellobied at 07:34 UTC . and being refueled with 2552 I.G (9018 kgs) . It departed to Juba at 08:54 UTC carrying 220 SACKS OF dura the load estimated to be about 18 tons , arrived Juba at 10:51 UTC. The aircraft took off from Juba Airport at 11:40 UTC maintaining FL 240 estimated time of arrival Ellobied 13:30 UTC . The crew was composed of the Armenian Captain, the F/O, a Sudanese Navigator, a Sudanese radio operator, Iraqi Flight engineer, Iraqi Navigator and an Armenian Technician.

The last contact with Juba ATC was at 12:00 UTC .

The first contact with Ellobied ATC was at 12:45 UTC .

At 13:05 UTC the aircraft contact Elobied -requesting clearance to descend to FL 60 as stated by Elobied ATC .

At about 1315 Elobied ATC contact the Aircraft but there was no response . after estimated time of arrival elapsed and no response from the aircraft Elobied ATC contacted all nearby Airports enquiring about ST-SIG and their answer was negative .

On the morning of 12/05/2004 Elobied Airport Authority received a message from the Armed Forces that the aircraft crashed in a forest near a village called Tatal , Habilia scheme .

1.1 History of Flight :-

The Antonov -12 serial number 1420101 Registration ST-SIG was designated to transport cargo from Elobied to Juba Airport . The aircraft left Khartoum Airport on Sunday morning 09/05/2004 at 04:50 UTC with nine crew members composed of two Armenians , the Captain and the Ground Engineer who also acted as a load master , a Sudanese First Officer , a Sudanese Navigator, a Sudanese Flight Engineer, a Sudanese Radio Operator , three Iraqi (one Navigator , one Flight Engineer and one Electrical Engineer) with un validated license from Sudanese Authority . The aircraft with the mentioned crew managed to carry out five flights from Elobied to Juba and back on dates 09-10 -11/05/2004 . After each flight to and from Juba the aircraft up lift 9018 kg (2552 L.G) of fuel at Elobied Airport by Matthew Petroleum Company .

On the 11/05/2004 for the second flight to Juba the Aircraft was refueled with 9018 kgs. of Jet A1 and it was loaded with 15 tons of Dura Sacks as per the cargo manifest (estimated 18 tons) . The crew was composed of the Armenian Captain and Ground Engineer , the Sudanese first officer , the Sudanese Navigator , the Sudanese Radio Operator , the Iraqi Navigator and Iraqi Flight Engineer . The Aircraft arrived Juba Airport at 10:51 UTC on 11/05/2004 . Being unloaded it took off at 11:40 after submitting a flight plan showing F/L 240 , true air speed 290 , estimated elapsed time to Elobied 01:50 hrs , fuel endurance 5 hrs , alternate Aerodrome Malakal , Total on board 06 (they were seven persons).

The aircraft serial number 1400101 – flight number MGA . 002A took off from Juba Airport at 11:40 UTC with clearance to FL 240 . after twenty minutes the crew of MGA 002 A contacted Juba Airport informing that they reached FL 240 and Juba ATC informed them to contact Khartoum ATC on 127.3 and they did .

At 12:08 F/O : Magal 002A FL240 abeam Malakal 12:40, ETA Elobied
13:30

12:10 ATCC : Call abeam Malakal
12:39 F/O : Checked abeam Malakal
ATCC : Report VHF contact with Elobied
12:53 F/O : Magal 002A VHF contact with Elobied.

The above communication was a transcript from Khartoum Centre.

The following communication from the statement of the duty ATC at Elobied Airport.

At 12:45 UTC MGA – 002A contacted Elobied ATC and the Metar of Elobied was relayed to the crew .

At 13:05 UTC MGA -002 A requested clearance to descend to FL 60 and was cleared for that . Elobied ATC requested MGA – 002 A to call back at 25 N.M.

At 13:15 Elobied ATC called MGA -002 A several times but no reply from it.

At 13:26 Elobied ATC requested from an over flying AN-26 to call MGA-002A but the AN-26 failed to contact MGA-002 A .

At 13:35 – 13:40 UTC Elobied called the nearby Airports enquiring if MGA-002 A landed any where but received negative reply .

1-2 Injuries to persons

Injuries	Crew	Passengers	Total in Aircraft	Others
Fetal	7	N/A	7	N/A
Serious	N/A	N/A	N/A	N/A
Minor	N/A	N/A	N/A	N/A
None	N/A	N/A	N/A	N/A
Total	7	N/A	7	N/A

The Captain and the Ground Engineer were Armenians . The First Officer , Navigator and the Radio Operator were Sudanese . The Flight Engineer and the Second Navigator were Iraqi.

1.3 Damage to Aircraft

The aircraft was destroyed due to crash and collision with large trees .

1.4 Other Damages

During the impact a large number of trees from the forest were being cut off or broken .

1.5 Personnel Information

a) The Captain

Total flying experience	not available
On type	10350 hrs.

Last 90 days	not available
Last 28 days	49 hrs.
Last 7 days	24 hrs.

b) The F/O

Total flying experience	1300 hrs. approx.
Last three months	150 hrs. approx.
Last 28 days	70 hrs. approx.
Last 7 days	24 hrs.

1.6 Aircraft Information

The Antonov 12 A number 1400101 manufactured by Voroniz Avia production Association on 07/07/1961 . Entered the Sudan Register of Civil Aircraft on 16/07/03 with registration Marks ST-SIG . Certificate of Registration had a full validity . The aircraft was owned by Elmagal Aviation Services Co.Ltd .

Certificate of Airworthiness valid till 01/07/04 .

Last maintenance carried out was check No.10 on 30/12/03 at Sharjah Airport by Volga Dnepr Gulf maintenance base .

Aircraft total flying hrs. since new 16609:24 and cycles 7753 .

Total flying hrs since overhaul 6498:10 and cycles 2152 .

The last recorded flying hrs was during February 2004 which was 37:50 hrs .

Hrs flown since last periodic inspection(from ATC movement)was 388 hrs .

Certificate of Release to Service and Certificate of maintenance review at time of accident was not valid .

Hours and Cycles flown for the last two months:

From	Till	Hours	Cycles	Cyc. per hrs
1 November 2003	30 November 2003	15:00	8	1:52
30 November 2003	31 January 2004	47:10	19	2:28
31 January 2004	13 February 2004	37:50	15	2:31

4. Preservation records: "first part of airframe log book missed"

Date	Action	Period
26/07/1989	Preserved	3 Months

5. Engines change records:

Date	SN removed	SN installed
07/04/1981	#1 C2335236	H2335226
17/08/1984	#4 H28036027	H27736025
13/12/1988	#4 H27736025	H2116157
21/02/1989	#1 H27926019	H27516082
21/02/1989	#2 H28036030	H2676017
21/02/1989	#3 H28136017	H2946169
26/07/1989	#1 H27516082	H2036191
27/08/1991	#4 ????????	
30/12/2003	#3 H2436063	H27626028
07/01/2004	#3 H27626028	H2046201

6. Maintenance records:

Date	Type of maintenance	Organization
07/11/2000	F-4	
13/01/2001	F-5 + life extension	
22/03/2001	ND Inspection	

31/03/2001	F-6	
25/07/2001	F-7	
20/11/01 – 18/01/02	Preservation	
20/01/2002	F-8	
07/02/02 – 27/05/03	Preservation	
14/06/2003	F-9	
30/12/2003	F-10	VDG

7. Overhaul records:

Nº	Date	TBO	Ult. Life
1			
2	14/12/1980		
3	13/01/1986	3'000hrs / 2'500 cyc / 6-9 year	
4	25/04/1990		
5	22/06/1995		17'000hrs / 8'000 Cyc / 35 years

No1 Engine:

Serial number: **H27626019**

Date of manufacturing: 1976
 First overhaul on 27/08/92
 Second overhaul 18/09/97
 Last recorded flying hours on 13/02/04
 Since new 3365:32 hrs.
 Since overhaul 908:55 hrs. 367 cycles.

No.2 Engine

Serial number H28536060
 Date of manufacturing 1985
 First overhaul 03/10/1991
 Last recorded flying hours on 13/02/04
 Since new 4735:43 hrs. 1640 cycles
 Since overhaul 3697:09 hrs. 1293 cycles

No. 3 Engine

Serial number H2046201
 Date of manufacturing 25/12/1970
 First overhaul 20/10/1976
 Second overhaul 18/03/1979
 Last recorded flying hours on 13/02/04
 Since new 13104:24 hrs.
 Since overhaul 85:38 hrs.

Engine No.4
 Serial number H2116154
 Manufacturing date 15/04/1972
 First overhaul 11/03/1985
 Last recorded flying hours on 13/02/04
 Since new 8654:54 hrs. 3367 cycles
 Since overhaul 2213:11 hrs. 683 cycles

1.7 Meteorological Information

From Satellite pictures there were low clouds and CBs along the route From Malakal to South of Ellobied accompanied by thunderstorms and rain on some areas . This led to development of conventional currents assisting sandy storms which reduced the vertical visibility.

Ellobied area at 13:00 UTC

Wind 60/04, there was few CBs, temperature 43/09, QNH 1006. This Weather was not relayed to the ST-SIG.

At Habilla Scheme rain stopped at about 13:00 UTC and aircraft crashed 18 minutes later.

1.8 Aids to Navigation

Ellobied Airport was equipped with VHF, VOR/DME.

1.9 Communications

VHF, HF

1.10 Aerodrome Information

N/A

Had no effect on the accident.

1.11 Flight Recorders

The aircraft had three types of recorders FDR type MCRP, Cockpit Voice recorder and a Foil recorder K3-63 which record three parameters Speed, altitude and g force.

The MCRP has eleven channels and four binary channels regarding Engines operation.

The MCRP and the Voice recorders did not record any information Regarding aircraft performance as they may be switched off or tapes were old and being exhausted or they were not being well maintained. The K3-63 was operating normal and gave number of flights and their Durations. There were thirteen flights.

1.12 Wreckage and Impact Information

On inspecting the wreckage it was evident that the aircraft was on a crash landing configuration with flaps 15 degrees and feathered propellers. The aircraft was intact till the moment of collision with the ground and thick trees. The aircraft hit the ground with its nose portion and bounced for 15 meters and then hit the ground again collided with the trees and slide on the ground.

Due to high impact force and high rate of descend the wings were twisted with their pick-up mounts and frames pulling the cockpit backward and compressing it within the central cargo compartment and keeping them squeezed between them. Parts of the aircraft were disintegrated and distributed along the crash path as seen on the crash site plan.

1.13 Medical and Pathological Information

All on board were burnt to death . No bodies were found.

1.14 Fire

Fire occurred on ground after impact and after the aircraft came to total Stop The fire was limited on the cockpit and part of the wings. The fire did not extend to the other aircraft parts or the forest.

The aircraft wreckage was found covered with unburnt branches which proved the limited fire which may be due to electrical shortage within the electrical equipment.

1.15 Survival Aspects

All occupants burnt to death.

1.16 Tests and research

As per the aircraft Flight Manual the fuel consumption stated there was compared with the actual fuel consumption and that confirmed by some very experienced Captains on this type of aircraft which show great difference due to environmental conditions and prolonged engine life conditions.

1.16.1 Aircraft Performance and Fuel Analysis

For aircraft performance and fuel management analysis the AN-12 manufacturer Operation Manual was being consulted and the flowing data was collected for two different flight levels . FL 17000 feet and FL 24000 feet .

The manual states that for engines type AN-20 M ground operation of engines And APU for 16 minutes fuel consumption about 482 Kgs . On flight the fuel consumption is as follows in regard to time , distance and T/O weight of the aircraft .

- For T/O weight 61 tons and FL 17000 feet

a) Fuel consumption on climb 869 kgs for 15 minutes and ground distance 10 km .

b) Fuel consumption on descend 255 kgs

“ “ “ descend time 10 minutes .

“ “ “ ground distance for descend 80 km .

c) Fuel consumption for level flight is 4.31 kgs / km or 2130 kg / hr .

- For T/O weight 46-47 tons and FL 24000 feet

a) Fuel consumption on climb 720 kg .

climb time 15 minutes .

ground distance to reach 24000 90 km .

b) Fuel consumption on descend 355 kgs .

descend time 13 minutes .

ground distance to descend from 24000 112 km .

c) Fuel consumption on level flight 3.31 kg / km or 1770 kg / hr

To reach a convenient conclusion regarding the fuel consumption of ST-SIG engines the statement of Juba Airport ATC was being consulted in addition to the figures on operation Manual . Those figures on operation manual were for an ideal engine or new engines but the AN-12 , ST-SIG , MGA 00 2 A engines were old and their life were being extended many times thus they would consume more fuel as it was found that ST-SIG reached flight level 24000 feet after 20 minutes from take off

Therefore the time taken to reached FL 24000 was compared with the Aircraft Operation Manual Time it was noticed that there was a delay in reaching the specified level while the climb speed was constant for both cases .

From this it was concluded that as there was increase in time , there would be increase in fuel consumption and increase in ground distance for climb .

Therefore increase in time was taken as a common factor for the fuel management calculation for the AN-20 M engines fitted to AN-12, ST-SIG. and was found to be 20/15 = 1.333

- Therefore

Flights en route Obied – Juba with T/O weight 61 tons and FL 17000 feet .

a) Fuel consumption on climb 1158 kgs .

Fuel consumption on descend 340

Ground operation 641

Fuel for level flight 2982

Total fuel consumption Obied – Juba 5121 Kilograms

** Fuel consumed on six flights Obied – Juba 30726 Kilograms

Flight en-route Juba- Obied T/O weight 47 tons and FL 240

Fuel consumption on climb 720*1.333	= 960 Kgs
Fuel consumption on descend 350*1.333	= 467
Ground operation	= 641
On level flight (114-33)/60*(1770)	= 2390
Total fuel consumed Juba - Obied	= 4458 Kilograms
Fuel consumed on five flights Juba- Obied	= 22290 Kilograms

Calculated fuel consumed Khartoum - Obied = 2955

Total fuel consumption on the period 9/5-11/5/2004 excluding accident flight
Was found to be = 55971 Kilograms ***

Fuel up-lift was as follows:

At Khartoum on 9/5/2004 13500 Kgs

At Obied from 9 to 11/5/2004 was

9018*5 45090

Total fuel up-lift = 58590 Kilograms

Available fuel before refueling at Khartoum in tanks on 9/5/2004 was
estimated as follows:

The aircraft left Obied to Juba on 6/4/2004 with 13500 Kgs of fuel and stay on
Ground at Juba till 27/4/04 the day it arrived Khartoum

Flight Juba-Khartoum.

Fuel consumption on climb = 960

Fuel consumption on descend = 467

Ground operation = 641

Level flight

Available fuel for flights = 2122 + up-lift = 60712 Kgs.

Therefore remaining fuel for the accident flight was

60712 - 55971 = 4741 Kgs.

This quantity was more than the estimated for the flight back to Elobied by
283

Kgs. but as the weather on day of accident was cloudy and rainy de- icing
System Certainly fully being used which increase fuel consumption by 8% as
per aircraft Flight Manual so:

The required fuel for the flight should be = 1.08*4458 = 4815 Kgs.

Fuel deficiency was 74 Kgs. If no de-icing system was being used the

Available fuel would give about 8 minutes which was enough to land Elobied.

1.16.2 Taking a similar aircraft total T/O weight 47 tons flying at FL210

Time taken to reach FL 21000 was 35 minutes

Fuel consumption for one hr = 2900 kg

Total fuel consumption from engine start to engine shut down 3500 during
period of 95 minutes .

Fuel consumption in last 35 minutes = 600 kg .

There for the same aircraft with the same T/O weight flying at 24000 ft .

Time taken to reach 24000 ft is about 40 minutes .

Fuel consumption for the first hr is 3314 kg .

The average time for a trip Juba – Elobied till engine shut down is 135 min.

$$\text{Remaining time fuel consumption is } = \frac{75 \times 600 \times 1.14}{35}$$

Total fuel consumption Juba – Elobied = 4780 kg

Total fuel consumed in return flights = 23900 kg

Fuel consumed in the first hour for loaded aircraft of T/O weight 61 hrs
will be $\frac{61 \times 2900}{51}$

Elobied Juba time 135 minutes

$$\text{Fuel consumed after the first hr} = \frac{75 \times 61 \times 600}{51 \times 35} = 1538$$

$$\text{Total fuel consumption Elobied Juba} = 5005 \text{ kgs}$$

$$\text{Total fuel consumed in 6 flight Elobied -Juba} = 30030 \text{ kgs}$$

$$\text{Fuel consumed Khartoum - Elobied empty a/c} = 2900 + \frac{17 \times 600}{35} = 3191 \text{ kgs}$$

$$\text{Total fuel consumed excluding accident flight} = 57121 \text{ kgs}$$

On 6/4/04 the aircraft left Elobied to Juba with fuel quantity 13500 kg the aircraft was grounded at Juba till 27/4/04 the day during which it arrived Khartoum the flight took 2:46 hrs ie 166 minutes .

$$\text{Fuel consumption Juba-Khartoum} = 5386 \text{ kgs}$$

$$\text{Fuel consumption Elobied -Juba -Khartoum} = 10391 \text{ kg}$$

$$\text{Remaining fuel} = 13500 - 10391 = 3109$$

$$\text{Fuel up lift at Khartoum on 9/05/04} = 13500$$

$$\text{Fuel up lift at Elobied} = 45085$$

$$\text{Total fuel up lift period 09/5 to 11/05} = 61694 \text{ kgs}$$

$$\text{Total fuel consumed excluding accident flight} = 57121 \text{ kgs}$$

$$\text{Remaining fuel for accident flight} = 4573 \text{ kgs}$$

$$\text{Required quantity for the return flight should be} = 4780 \text{ kgs}$$

$$\text{Lack of fuel for return flight} = 207 \text{ kgs}$$

Fuel consumed after first hr (accident flight)

$$= \frac{42 \times 600 \times 1.14}{35} = 821 \text{ kg}$$

$$\text{Total fuel consumed on accident flight} = 821 \text{ kg} + 3314 = 4135$$

The remaining fuel minus the unusable fuel was about 0.07 which was Consumed due to switching on the De- Icing system .

1.16.3 Another approach for fuel management was being used by collecting data from previous technical log recorded fuel quantity and total time for each flight for example the aircraft was refueled with 13500 kg Jet A1 at Elobied . It took off to Juba and returned back with 3720 kgs. remaining fuel . The time taken for the flight was 4:20 hrs that is with a rate of about 37. kgs / min

Date	Route	Time Iron engine start to engine shut down	Consumed fuel	Up lift fuel	Remaining
9/05/04	HSSS-HSOB	77 min.	2849	13500	3109
	HSOB-HSSJ	131 min	4847		
	HSSJ-HSOB	143 min	5291	9018	
	HSOB-HSSJ	134 min	4958		
	HSSJ-HSOB	131 min	4847	9018	
10/05/04	HSOB-HSSJ	134 min	4958		
	HSSJ-HSOB	134 min	4958	9018	
	HSOB-HSSJ	134 min	4958		
	HSSJ-HSOB	130 min	4847	9018	
11/05/04	HSOB-HSSJ	137 min	5069		
	HSSJ-HSOB	134 min	4958	9018	
	HSOB-HSSJ	134 min	4958		
	HSSJ-HSOB				
			57498	58590	

The total amount of fuel available (Fuel up-lift) on period 09/5 to 11/05 was 61699 kgs

Total fuel consumed excluding accident flight 57498 kgs.

Remaining fuel for accident flight 4201 kgs.

The remaining fuel will operate the aircraft for 114 minutes

The K3-63 recorder show that the time for the accident flight was in the range of 102 to 104 minutes and if the time taken from engine start till take off was considered to be in the range of 10 to 12 minutes this will give flying time about 102 minutes which as per k3-k6 recorder and proves lack of fuel for that flight .

1.6.4 Another approach for the fuel consumption was compared with the total fuel consumed by a similar aircraft in 1:35 hours total time on a test flight to simulate AN-12 fuel consumption neglecting flight level and loading.

The ST-SIG flight time as per the recorder K3-63 added to it the ground operation before take-off and after landing as 15 minutes.

Therefore:

09/05/04 flights

$$\begin{array}{ll}
 \text{Khartoum- Elobied} = (57+15)*3500/95 & = 2653 \text{ Kilograms} \\
 \text{Elobied - Juba} = (111+15)*3500/95 & = 4643 \text{ Kilograms} \\
 \text{Juba - Elobied} = (123+15)*3500/95 & = 5086 \text{ /////} \\
 \text{Elobied - Juba} = (114+15)*3500/95 & = 4752 \\
 \text{Juba - Elobied} = (111+15)*3500/95 & = 4643 \\
 \text{Total fuel consumed on 09/05/04} & = 21777 \text{ Kilograms.}
 \end{array}$$

10/05/04 flights

Obied – Juba	= (114+15)*3500/95	= 4753
Juba – Obied	= (114+15)*3500/95	= 4753
Obied – Juba	= (114+15)*3500/95	= 4753
Juba – Obied	= (110+15)*3500/95	= 4605
Total fuel consumed on 10/05 04		= 18864 Kilograms

11/05/04 flights

Obied – Juba	= (117+15)*3500/95	= 4863
Juba – Obied	= (114+15)*3500/95	= 4753
Obied – Juba	= (114+15)*3500/95	= 4753

Total fuel consumed on 11/05/04 excluding

Accident flight = 14369 Kilograms

Total fuel consumed for the assigned flights excluding accident flight

Was found to be = 55010 Kilograms

Fuel in tanks before refueling at Khartoum on 09/05/04 was calculated

In accordance to previous flights as follows:

Ellobied – Juba – Khartoum = 12572 Kgs.

Total fuel up-lift = 13500 +9017*5 + 928 = 59513 Kgs.

The remaining fuel for the accident flight = 4503 Kgs.

It was less than the required quantity by 250 Kgs.

1.17 Organizational and Management Information

When the Investigation Board referred to the Company to collect some information regarding crew training and flying hours nothing was found except letters of employment and transfer. There was no history available about any of the crew members.

There is no Executive Manager for the company. The company is being managed by the Director General who is the owner of the company. The appointment of the Operation Manager, who was the F/O on the accident flight, did not comply with the Approved Operation Manual as it stated that no person may serve as Manager of Operation unless he:

- a) holds, or had held an ATPL and had at least three years of experience as P.I.C of A/C over 12500 Kgs.
- b) has had at least three years of experience as director of an operation using large aircraft or position of comparable responsibility.
- c) has the minimum of two years experience in supervisory capacity dealing with flight personnel.

The Operation Manager will exert overall control of company ground

operations, maintenance department and all flight crew to insure the development of flight procedures for a safe and economic operations. His duties will include final acceptance of all flight crew personnel, upgrading of all crew members by means of periodical check held by flight examiners so as to meet the requirement of CAA.

The F/O of the accident flight was appointed as Operation Manager on first of February 2004 and on 06/05/04 he was transferred from Operation Department and appointed as a F/O on either AN-26 or AN-12 as per the transfer letter dated 06/05/04 and that was due to the fact that another person was being appointed as Operation Manager since 03/05/04. Then on Saturday 08/05/04 another letter was being issued to the attention of F/O informing him to be on his previous post and the other person to takeover all operations duties.

The F/O and the other crew members left to Elobied on Sunday morning on 09/05/04. From what mentioned above it was certain that there is an influence of company management on technical matters accompanied with ignorance to their own Operation Manual and to CAA Regulations.

1.18 Additional Information

None

1.19 Useful or Effective Investigation Techniques

None

2- Analysis

2-1- General

2-1-1 The Crash Site :-

After crash the aircraft was disintegrated, The cockpit with the inverted wings and engines were situated 90 degrees to the crash path in a North – East direction and the tail portion composed of rear part of the cargo compartment ,elevator and rudder was found situated in the direction of the crash path in front of the wings group. Fire broke out on inner parts of the wings (fuel tanks group zero) and cockpit where the crew members were burnt to death and no bodies were found except some boons of human bodies.

The aircraft parts slide on the ground colliding with thick trees for a distance of 215 meters . The aircraft parts were found covered with un-burnt branches and trees which and fire was limited to parts described above .

2-1-2 The crew

The crew of the aircraft was composed of an Armenian Captain , Sudanese First Officer , Sudanese Navigator , Sudanese Radio Operator , Iraqi Flight Engineer , Iraqi Navigator and an Armenian ground engineer acting as a load master .

The different nationalities of the crew who do not speak same language , had not got the same standard, and lack of experience not being working together before obviously would delay reactions during emergencies and might lead to the worst when most of the crew had not got the required experience on the type of aircraft they were flying .

The crew members training should include proper flight crew co-ordination and training in all types of emergency or abnormal situation or procedures regarding malfunctions of different systems, and human performance and limitations. The flight crew members each should know his function during emergency. Unfortunately the company had no records regarding training of its crew in addition to the fact that it was the first time for that crew to work together even they did not meet before.

The first officer experience on AN-12 did not exceed few hours and his last base check was on An. 26 . The flight engineer did not fly this type for a long time nearly 10 years and his competency check was being done on IL 76 simulator in addition he was not validated by CAA Sudan to fly a Sudanese aircraft . The Iraqi Navigator had the same case .

The Sudanese navigator license expired some years ago

The Armenian Captain arrived Sudan on Friday . 5/ 05 / 2004 and flew with the crew on 9/5/04.

2-1-3 The Aircraft

The Aircraft was on a crash landing configuration 15 degrees flaps and feathered propellers. The aircraft was intact till the moment of collision with the ground and trees and afterwards started to disintegrate. Due to high impact force with trees and high speed of descend the wings were twisted with their pick-up mounts and frames and turned up-side-down pulling and keeping part of central fuselage and cockpit squeezed between them and initiating fire due to ignition of residual fuel or electrical shortage source. Due to high impacting force and speed engine number 3 was displaced from its mounting position and engine number 4 was thrown above the wing in front of number 3 engine on top of the compressed portion of the front cargo compartment.

According to eye witness statements the aircraft was seen flying over the Tatal village at low altitude with rocking wings and a sort of coughing engine sound. After the aircraft left the village territory a black smoke was seen coming from the right side engines with change of engines sound (irregular snoozing). Then it was seen going down into the forest.

As being noticed on AN. 12 aircraft when increasing engine power a heavy black smoke appears from the engines due to the quantity of fuel being injected into the combustion chambers and as there is no way to overhaul such type of engines due to lack of spare parts, engine's life is being prolonged by the manufacturer for additional hours after a certain specified check being carried out by the Maintenance Organization and being certified by the Manufacturer or a certified Agent.

2-1-4 Fuel Management

As there was no on flight fire or fire in the forest and as the fire was limited to the cockpit and part of the inner tanks fuel starvation was suspected, thus a similar aircraft was taken as an example and being flown for 1:35 hours with maximum take-off weight about 47 tons at FL210. During this period the total fuel consumption was 3500 kilograms and this was compared with the ST_SIG fuel consumption as seen on paragraph 1-16-4 and can be analyzed as follows:-

Date	Fuel up-lift Kgs	Total fuel in tanks Kgs	From	To	Fuel Consumed Kgs	Remaining Fuel in tanks kgs
06/04/04	13500	13500	Obied	Juba	6000	7500 as per tech log
27/04/04	-	7500	Juba	Khartoum	6500	1000
09/05/04	13500	14500	Khartoum	Obied	2653	11847
		11847	Obied	Juba	4643	7204
		7204	Juba	Obied	5084	2120
	9071	11137	Obied	Juba	4753	6384
		6384	Juba	Obied	4641	1743
	9017	10760				

10/05/04		10760 6007 10271 5518 9930	Obied Juba Obied Juba Obied	Juba Obied Juba Obied	4753 4753 4753 4605	6007 1254 5518 913
11/05/04	9017	9930 5067 9331 4578	Obied Juba Obied Juba	Juba Obied Juba Obied	4863 4753 4753 4753	5067 314 4578 - 175

As shown above the fuel for the return flight was less than the required quantity by 175 kilograms and as the weather was cloudy and rainy 3% of the fuel was additionally consumed that was about 143 kilograms. The deficient amount of fuel if available the aircraft might land Elobied Airport as it gives about 8.6 minutes Subtracting (175+143) from the required fuel quantity for the flight the remaining amount would fly the aircraft for just 102.6 minutes as per the K3-63 recorder.

The shortage of fuel or the amount of fuel being put in always was just enough To complete the assigned mission Elobied-Juba-Elobied without any reserve for alternate or hold with intended ignorance to weather conditions or emergency situation which may unexpectedly rise and that will certainly lead to accidents. It is the policy of the company to carry as much load as possible in the expense of fuel and this can be seen from the following breakdown of the ST-SIG total take-off weight on 11/05/04.

The weight of empty aircraft	36.600 tons
Cargo weight as per manifesto	15.000 tons
The authorized take-off weight of the aircraft as per aircraft flight Manual	61.000 tons
The available weight for fuel will be	10.000 tons

The actual cargo weight on 11/05/04 on the second flight to Juba was 18.000 tons and thus the actual take-off weight was about 64.000 tons . The fuel consumption increased due to overload in addition it was not the required quantity to carry out that mission which should be about 13.375 tons of fuel.

3- CONCLUSION

3-1 Findings

- a) The aircraft had a valid C of A from 11/01/04 up to 01/07/04
- b) Certificate of Release to Service expired on 30/04/04
- c) Certificate of Maintenance Review expired on 30/04/04
- d) The Captain, the F/O and Radio operator had got valid licenses at time of the accident.
- e) The Iraqi Flight Engineer, the Iraqi Navigator had no recent flights on the type and they were not being validated by Sudan CAA.
- f) The Sudanese Navigator license was expired since 31/7/01.
- g) Non of the Data Recorders were in operative condition except the Foil Recorder K3-63.
- h) All flights and handling of the aircraft were being carried out by the Captain as stated by the a lived Flight engineer who flew in the first flight On the day of the accident.
- i) The company has not got records for its crew training.
- j) The Insurance Policy covers only 5 crew members while the operating crew at time of accident were 7.
- k) the aircraft always refueled with the minimum required quantity of fuel.
- l) The statement of Elobied ATC contradict the recorded communications at Khartoum Centre which revealed that Elobied ATC statement regarding time was not correct.

3-2 Cause of Accident

- a) Fuel starvation due to Company fuel planning policy.
- b) The exhaustion of the Captain as he was handling all flights during the three days preceding the accident flight in addition to the weather on day of accident.
- c) Some of the crew members had limited experience on the type and three of them even did not fly on AN-12 for a long time which might aggravate the situation before the crash.

4- SAFETY RECOMMENDATIONS

- 1- All AOC holders should comply with the fuel quantity required for each flight as stated by the Regulation and recommended by on Annex 6.
- 2- All AOC holders should comply with recent Circulars issued by CAA regarding loading of aircraft to different Airports.
- 3- All AOC holders should keep detailed records of their crew training.
- 4- Airports Authorities should revise aircraft loading and fuel endurance when a Flight Plan is being submitted.
- 5- CAA should equip all airports with tape records to record all contacts and communications.
- 6- CAA should implement a procedure for revising the Flight Plans in regard of endurance period according to load manifesto and aircraft maximum authorized take-off weight which should be submitted separately with the Flight Plan so as to adjust and companies to comply with recent Circulars being issued.

